Space Weather Technical Forecast

Issued on Saturday, 04 February 2023 at 01:00 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-flares. Slight Chance of G1/Minor Storm, early on Day 1, but mainly Days 2-4 (05-07 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Low, with occasional minor C-class flares in the past 24 hours. There are currently seven sunspot regions on the visible disc. All the sunspot regions on the visible disc are all small and relatively magnetically simple, with only minor development over the past 24 hours and limited activity observed. No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by DSCOVR at L1, supported the arrival of a weak CME at 03/1050 UTC. Wind speeds are currently around 340 km/s and have remained at ambient levels throughout, with a peak of around 375 km/s. Density was initially average or below average but increased slightly as the CME arrived. Subsequent density values have largely been average, occasionally crossing the threshold to above average. The total IMF strength, Bt, was weak at 7nT or below before jumping to moderate as the CME arrived. The IMF strength, Bt, has since gradually returned to weak levels. The north-south component (Bz) varied weakly between +8/-8 nT. The Phi angle was mostly negative (towards the Sun), with a couple of periods of positive (away from the Sun). Geomagnetic activity was largely Quiet (Kp 0-2) with a couple of Unsettled (Kp 3) periods.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 remained at background levels throughout. High energy electron flux (greater than 2MeV) measured by GOES-16 was predominantly at background levels. The associated 24 hour electron fluence increased slightly through the period, with 2.20e6 integrated pfu observed at 04/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is forecast with the sunspots on the visible disc currently small and relatively simple. There is a slight chance of isolated M-class flares. New regions are forecast to emerge across the eastern limb throughout the period.

Solar Wind / Geomagnetic Activity: A weak CME arrived at Earth on 03 Feb (attributed to a CME released on 30 Jan); minor effects from this CME are likely to continue, albeit waning, through Day 1 (04 Feb). Wind speeds are currently at ambient levels and are expected to remain so through much of Day 1 (04 Feb). The uncertainty of the arrival of a HSS from CH74/- leads to reduced confidence for much of the period. The HSS is expected to bring Elevated wind speeds, and currently seems most likely to arrive on Day 2 (05 Feb).

Geomagnetic activity is expected to be mainly Quiet to Unsettled throughout. There is a chance of Active intervals and a slight chance of a G1/Minor Storm interval, early on Day 1 associated with waning effects of the current weak CME, but most likely through Days 2-4 (05-07 Feb) as the anticipated HSS arrives.

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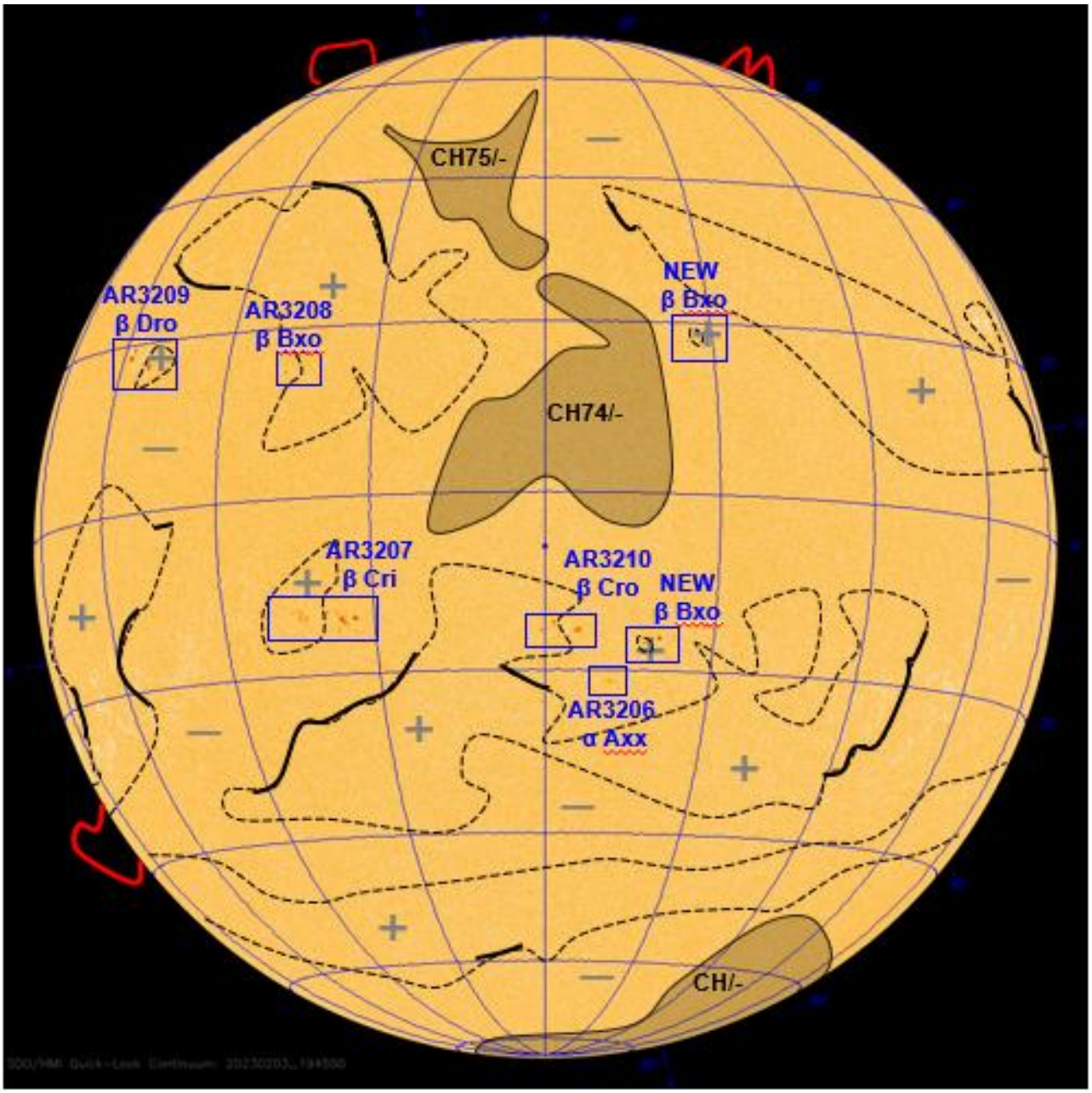
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES-16 is expected to remain at background levels throughout. Electron flux is expected to remain largely at Background to Moderate levels. Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 03/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A weak CME arrived at Earth on 03 Feb (attributed to a CME released on 30 Jan); minor effects from this CME are likely to continue through Day 1 (04 Feb) and gradually wane.

Solar wind speeds are currently at ambient levels, and are likely to remain so through Day 1, perhaps seeing a small increase to Slightly Elevated levels. Speeds are expected to increase to Elevated levels upon the arrival of a HSS from CH74/-. The timing of the arrival of a HSS is currently low confidence, with Enlil suggesting an arrival during the second half of Day 1, but empirical and persistence methods suggesting an arrival time later on Day 2 or on Day 3 (05-06 Feb). The most likely arrival of the HSS is likely to be Day 2, with the anticipated connection lasting for two days. However, there remains significant uncertainty in this.

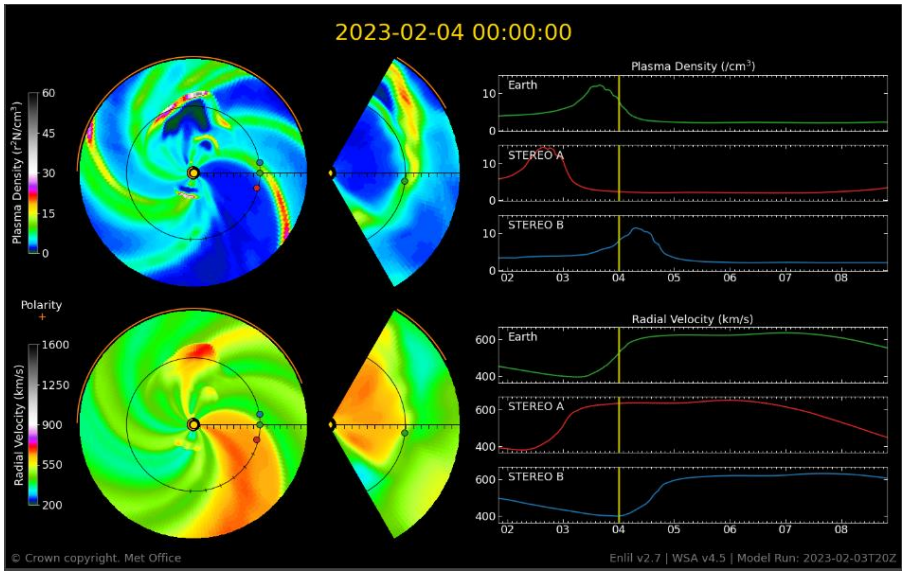
Geomagnetic activity is expected to be mainly Quiet to Unsettled throughout. There is a chance of Active intervals and a slight chance of a G1/Minor Storm interval, most likely early on Day 1 with the waning effects of the current weak CME effects, and again on Days 2 to 4 associated with the arrival of a coronal hole HSS.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	10	20	20	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil Earthbound CMEs observed on available imagery.

Figure 2: MOSWOC Enlil showing the arrival of a HSS late Day 1 (04 Feb). This seems too early given the position of CH74/- on the disc. Recent runs have delayed the onset of the HSS towards Day 2.



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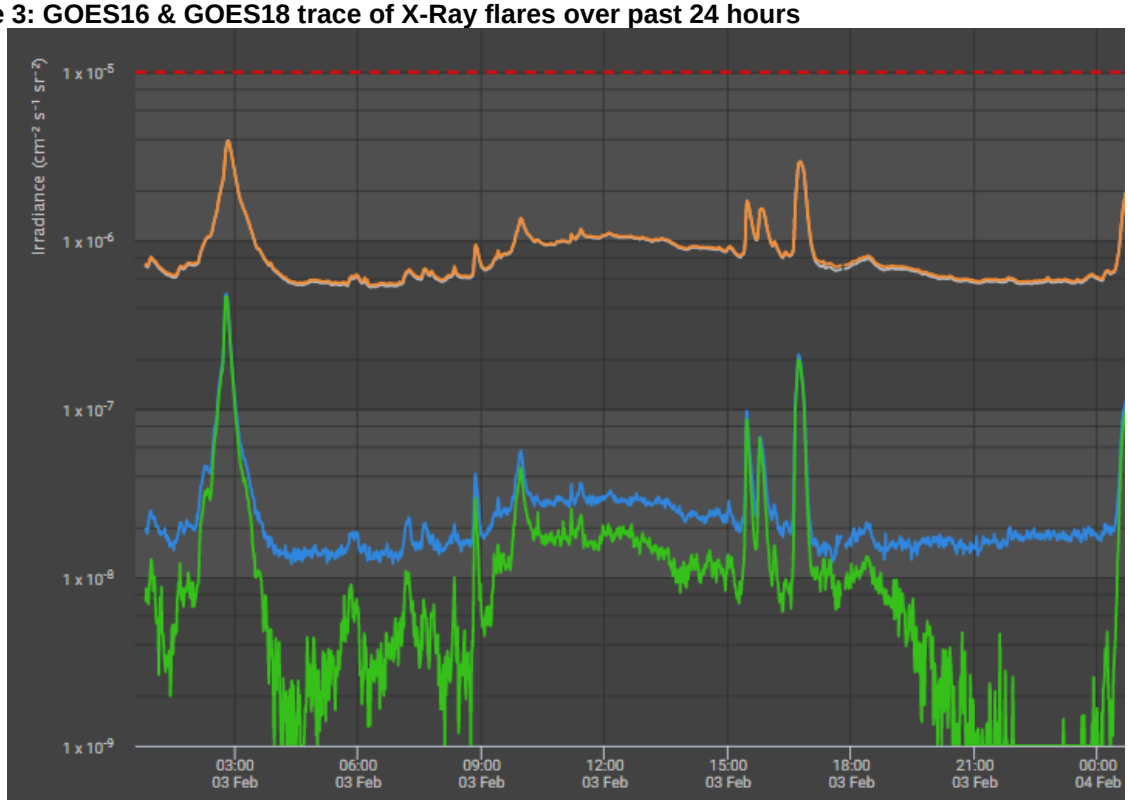
Radio Blackouts - X-Ray Flares:
There are currently seven sunspot regions on the disc, all of which are small and relatively magnetically simple. Some minor growth has been seen in the last 24 hours, with the emergence of a small unnumbered region in the southwest of the visible disc and continued proliferation of trailing spots for AR3207.

AR3209 has been reclassified Dro/Beta, as it continues to emerge from the eastern limb and foreshortening effects on imagery of the region lessen.

STEREO-A EUV imagery shows two areas of bright flux, suggesting that new regions are due to rotate across the eastern limb during the period. Helioseismograph data supports the arrival of a potential region across the southeastern limb on Day 1 (04 Feb), with further regions emerging across the northeastern limb during Day 2 or Day 3 (05-06 Feb).
Activity is expected to remain Low with only a slight chance of increasing to Moderate with any isolated M-flares that may occur.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES16 & GOES18 trace of X-Ray flares over past 24 hours



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Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux as observed by GOES16 is at background levels, and is currently expected to remain as such throughout the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at normal background to Moderate levels, and is expected to remain so throughout much of Day 1 (04 Feb) due to waning effects of the CME arrival on 03 Feb. There is reasonable confidence in this. A slight recovery is possible later on Day 1 into Day 2 (04-05 Feb). However, uncertainty with the arrival time of a HSS complicates the forecast during this period (see Geomagnetic Storms section). The HSS is expected to suppress flux levels once again by Day 2 or Day 3 (05-06 Feb) and for the remainder of the forecast period.

Electron fluence is expected to remain well below the Active (1e8 integrated pfu) threshold. A slight rise is possible on Day 2, with this trend supported by MOSWOC REFM, which is forecasting a steady trend well below Active. Recurrence would suggest fluence values will see a marked increase (yet remain below Active) during Day 2. However, since CH74/- is a larger and more defined feature on this rotation, the associated HSS is expected to disrupt electron fields more than on the previous rotation with suppressing effects lasting until the end of the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	5	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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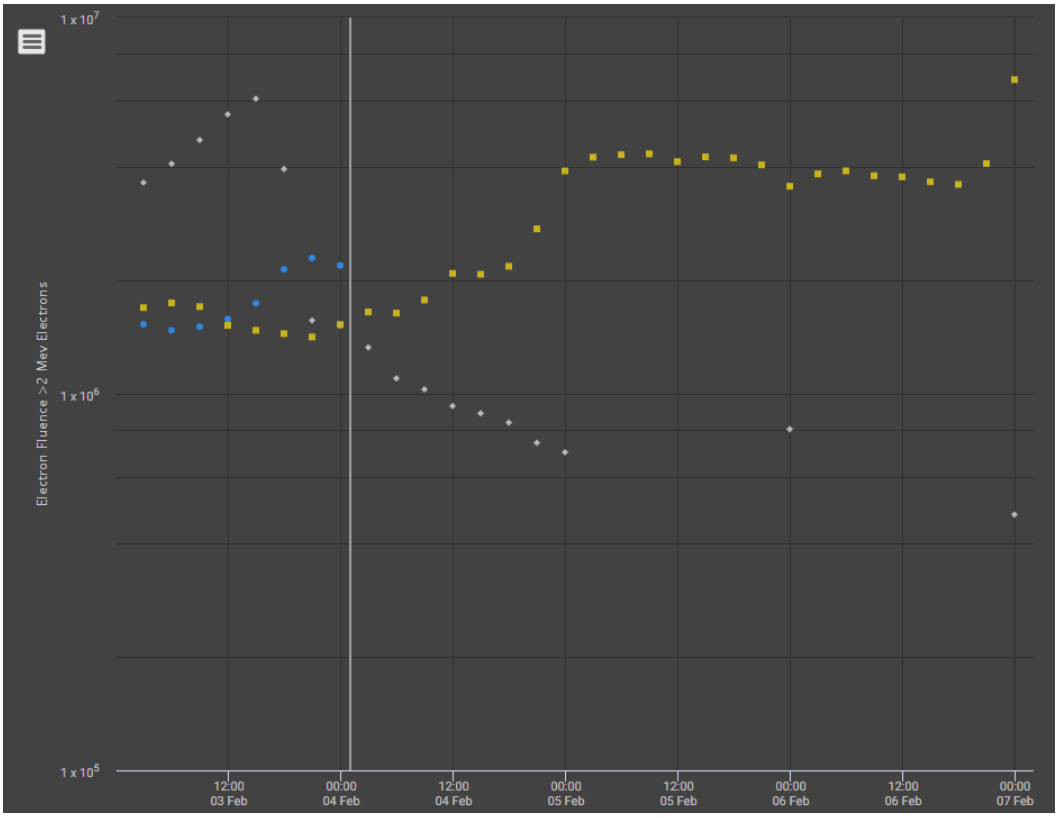
Figure 4: MOSWOC REFM shows a trend well below the Active (1e8 integrated pfu) threshold, accepted as good guidance. Recurrence values not followed due to coronal hole rotational variation.



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